

# Putting the Pieces Together: Using Cattle to Build Soil for Crops

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Raising livestock AND crops is an important topic to me and perhaps one of the most significant keys to the success of Elmwood Stock Farm.

In some parts of the country either you ride a horse following livestock and are called a rancher or you ride steel, grow crops and are a farmer. Not both. Fortunately, I grew up in central Kentucky where, due to topography and climate, we did some of both. Few people had enough land to run enough cattle alone to make a living. Likewise, few farms laid in a manner that allowed someone to raise only high value crops. A lot of acres in Kentucky are only fit for livestock.

My family raised hemp in the forties, stripped bluegrass in the fifties, notilled in the early seventies and plugged float trays in the early eighties. Now, in a day and time when everyone and is specializing for the sake of efficiency and differentiation and/or trying to get larger for economies of scale and leverage in order to succeed, we at Elmwood Stock Farm are relatively small and very diverse. We are diverse both in what we grow and how we market. We grow over 60 different crops, five different types of livestock and market all of this in numerous wholesale and retail methods as price setters and price takers in contracts and open markets, by ourselves and in coops with others.

We are management intensive but specialist of nothing. Often there are so many balls in the air it seems we are just a cat's whisker from everything flying apart. We have been certified organic for 15 years, selling mixed produce to our community for over 25 years and farming in the central Ky community for at least five generations. Probably the single greatest factor that has allowed us to last this long is the fact we have always farmed livestock and crops together.

What does this combination do? It allows you to cut costs while adding value and reducing risk.

- It allows one to add value-sell higher up the food chain at little to no cost.
  - sell chicken, eggs, pork – not loads of grain
  - sell steaks by the ounce – not hay by the semi load
  - as we add value moving from commodity to ready-to-consume products a side benefit is this often also means less total pounds or bulk is leaving the farm. And the fewer pounds that leave the farm means the fewer that needs to be brought in or generated as inputs.

- it spreads your risk – market and weather (you can almost always be happy –or sad)
  - when its wet, crops might be rotting but the cattle are fat
  - when its dry, forages might be short
- it cuts cost
  - selling beef and bulls with no feed cost
  - we raise 90 acres of grain and food crops with no annual fertility cost

**How does it work?** By managing the livestock in a certain manner, we make them work for us and they pay us to get to do it. Managed properly, ruminants specifically can have next to no expenses themselves and they build the soil and generate significant income while doing so. They will pay you a few hundred dollars an acre to improve the soil over a few years to the point that it can then grow crops that will generate a few thousand dollars an acre.

**How does raising crops and livestock separately not work?** If one tries to raise livestock (ruminants specifically) alone, it is quickly realized that it takes a tremendous amount of land to run enough of the livestock to make a decent living. This usually results in over grazing, which depletes the soils and results in both purchased feed and fertilizer costs. Or, it results in confinement and the even greater feed costs and waste management issues.

Conversely, if one doesn't care for animals and chooses to raise grain, or only has a small amount of acreage so chooses to raise only high value, perishable food crops in order to generate as much money as possible on the acreage, the soil gets worn out both from physical tillage and /or chemical alterations. The soil also loses its fertility from continually having its stored energy and minerals harvested and hauled off the farm, requiring an ever increasing amount of fertilizer to be hauled back in a great expense.

Separated, both of these enterprise often have ever increasing expenses that results in tighter margins. Combined, these two enterprises, working together, significantly reduce costs while often allowing for value adding that results in an ever increasing margin. If I could till and crop every last inch of my land, I would still have ruminant livestock.

So let's get to the important stuff. **How do ruminants increase fertility and build the soil for cash crops?** 1)The growing of legumes captures and builds nitrogen. 2) There is an increase in soil biology. 3) There is an increase in soil organic matter.

- 1) Legumes: Let's cut to the chase and talk about "where will the nitrogen come from if I don't buy it" for all my high yielding, high value cash crops? First, a good portion of the forages we grow will be legumes. And if it is not given nitrogen, certain biology in the soil will capture it out of the air and supply it to the legume plant in exchange for a small amount of plant and root exudates. Once pulled out

of the air by this nitrogen-fixing biology, this is captured N. It is stored in the plant, in the roots and in the nodules on the roots.

On the other hand, if plenty of N is provided to the plant to begin with by fertilizer, for example, then the plant has no reason to develop this symbiotic relationship with nitrogen-fixing bacteria and nitrogen-scavenging fungi, so they do not proliferate and are not there when the artificial N runs out nor are they present to provide the other benefits they offer like protection from pathogens and storage mechanisms for nutrients. Also, how the legume is harvested determines how much created N is captured and held for later use. If the plant is mowed for hay, then only the below-ground portion is captured while all that carbon and mineral components of the above-ground growing part of the plant is removed. If the plant is allowed to grow to maturity and then turn brown or winter freeze, the majority of the brown above-ground portion of the plant will be lost through volatilization and erosion before it ever falls over and comes in contact with the soil.

But if this same legume is consumed by livestock, it is run through a quick composting process (the digestion process of the rumen) that stabilizes it. Then it is applied directly to the soil where it can be immediately physically and chemically incorporated into the soil profile. And that portion of the green plant that is not consumed by the animal, if it is trampled down into contact with the soil surface, can also then be incorporated into the soil profile by the soil biology, such as beetles and worms, all the way down to the tiniest bacteria and fungi.

There is also the physical incorporation of the entire plant we are all familiar with when we do a plow down to prepare the soil for planting new crops. This has the benefits of capturing the entire plant by physical incorporation that puts the plant in proximity of the soil biology, but it has the detriment of physical tillage which results in huge releases (or burning off) of organic matter along with physical destruction of the soil structure.

Forage legumes grown in conjunction with grasses, improve the soil more than either type of forage alone. The legumes generally have deeper roots that allow them access to more minerals and water than the grasses as well as the nitrogen-fixing rhizobia. This allows them to generally grow larger and yield more on a per plant basis than grasses, but they cannot fill in and be dense enough to use all exposed soil. The grasses, whether sod-forming or stool types, have the ability to fill in the bare gaps of soil between each individual legume plant, making an overall denser stand. The grasses also will use any available nitrogen that is already in the soil, which forces the nitrogen fixing rhizobia to have to work for their living. Then the grasses are there to use any excess nitrogen they might generate which can be up to 30-50#N/ac/yr. So growing grasses and legumes together is a case where the whole is greater than the sum of its parts. More total tons of forage grown. More nitrogen captured, created and then kept in the

production cycle. More and varied roots both in the shallow and deeper soil mining nutrients and water and improving the overall soil structure.

One caveat - trust the legume and the nitrogen fixing rhizobia relationship, and they will work for you.

"Soybeans are one of the most common legume crops grown in Missouri. Soybeans can add 30 to 50 pounds of nitrogen per acre to the soil. When grown in rotation with corn, grain sorghum or wheat, outside nitrogen fertilizer can be reduced. A common recommendation in Missouri for corn following soybeans is to reduce nitrogen fertilizer rates by 30 pounds nitrogen per acre."

<http://extension.missouri.edu/p/WQ277>

In addition, this study from Canada suggest that the amount of N symbiotically fixed from a soybean crop can be as high as 134 lb/ac.

<http://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/soils-fertility-and-nutrients/soil-improvements-with-legumes>

Some researchers even go so far to as to suggest legumes leak off an extra 30-50 pounds of N into the soil beyond the huge amount that the legume plant captures from the bacteria and use themselves. "Almost all of the fixed nitrogen goes directly into the plant. However, some nitrogen can be "leaked" or "transferred" into the soil (30-50 lb N/acre) for neighboring non-legume plants" (Walley, F.L., G.O. Tomm, A. Matus, A.E. Slinkard, and C. van Kessel. 1996. Allocation and cycling of nitrogen in an alfalfa-bromegrass sward. Agronomy Journal, 88, 834-843)

Many universities recommend including legumes in crop rotations or pastures and then credit them with adding some nitrogen. So they then recommend decreasing the N fertilizer rate some but not significantly or entirely. If you underestimate the amount of N that the legume and its N-fixing friends will contribute and then you still supply some N. The rhizobia will not be required to work hard or at all so they won't so they will therefore disappoint. A self-fulfilling prophecy.

I think it is safe to say, legumes give us a lot of free nitrogen. If we let them or even make them, they probably give us a lot more than most of us give them credit for. And, grown with grasses, legumes give us more total N and total biomass than grasses or legumes grown alone.

- 2) Biology. Grazing livestock can encourage an increase in soil biology that improves the overall soil health but also is ANOTHER SOURCE OF N besides legumes. This second point was a big a-ha moment for me many years ago. I had grown up being taught and seeing in person on a daily basis all the positive effects that crop rotation had and the economic and ecologic benefits of farming

both livestock and crops. But it was the worry of running out of nitrogen that kept me wondering if it was truly possible to farm entirely organic without suffering tremendous yield loss. I knew all the N that was available from plowing down a green forage and all the N that legumes fixed, but was it enough to last into the fall for long season, high N crops? And where would the N come from the next year? Then through a series of composting talks at SSAWG and soil talks at Kentucky State University's Third Thursday Thing at the research farm, it finally got through my thick skull that nitrogen is protein and protein is nitrogen. Then we became certified organic.

After water, proteins are the second largest component group of most living animals. It is the primary building blocks of muscle and tissue among other things. And proteins are made up of chains of amino acids hooked together in different ratios and different shapes. But the important thing for us to know is that chemically, amino acids are made up of carbon, hydrogen, oxygen and nitrogen. And soil biology are tiny animals.

Really, this shouldn't have been such a surprise to me. I knew since kindergarten that the Native Americans taught the pilgrims to use dead fish to help them grow their corn crops. Or, going the other way, one can literally inject bales of low-food-value straw and fodder with anhydrous ammonia ( $\text{NH}_4$ ) to raise the protein level and increase the feed value.

When you consider that the four most common elements of living organisms in order are carbon, hydrogen, oxygen and nitrogen, you realize that when you have living organisms you have a source of nitrogen. And this definitely includes the biology in the soil, from a mouse to a worm to a nematode to a fungus to a bacteria. Living biology or dead biology contain a lot of nitrogen. And, the real kicker for us as farmers - this source of nitrogen is often not included in soil test. It's tough to measure and it's always changing.

To summarize, a plant needs nitrogen to grow. That nitrogen can be supplied directly to the plant in the form of nitrate. This is what I would call chemical farming involving reductive chemical analysis. You are spoon-feeding exactly the elemental components needed to build the plant you are growing. It involves amazing scientific knowledge and is perfectly exemplified by hydroponic growing of beautiful vegetable that have never touched a thimble of soil. But nitrogen can also be supplied to plants from amino acids through various equally amazing biological processes performed by different biology in the soil. This is what I would call biological farming. And it results in a huge web of billions of tiny livestock living in the soil. They can perform many different jobs and task while they are alive and well and then the ultimate task of being food for other microorganisms in the soil or for the plants that are growing above the surface. But if we are not farming biologically from the beginning, then we do not have the biology available in the soil when we need it. If we feed the plant directly chemically at the beginning, then there is no reason for the plant to form a

symbiotic relationship with nitrogen fixing bacteria and nitrogen-scavenging fungi. Then if the plant runs low on nitrogen, or runs low on water or is attacked by a pathogenic fungus (like "root rot"), those symbiotic microorganisms are not there with a vested interest (and documented capability) to defend, protect and help their host plant in its time of need. This stuff really happens and this is another case of the whole being greater than the sum of its parts.

- 3) Simply put, increasing soil organic matter improves the soil's texture, increases both its air and water holding capacity and increases its fuel tank to hold more plant-growing fuel.

Soil Organic matter is often thought of as the dead plant debris, fodder, straw and, leaves that are incorporated into the soil. In fact, that is just "dead plant debris". Very volatile and unstable until the soil microbes decompose it to a point where it is more stable and unrecognizable. It is then soil organic matter. Further decomposing to an even more stable form results in humus.

Organic matter and/or humus bring many benefits to the soil. Organic matter can hold a tremendous amount of water, like a sponge, as well as air. Both of these are vital to all the aerobic biology living in the soil as well as the plant roots. Again being like a sponge, organic matter helps the soil structure by keeping it loose and pliable, allowing water and air easy passage. It holds water, holds air and opens the soil up to allow passage for water and air.

In terms of nutrients, organic matter serves two purposes. First, it can be a source of nutrients as it slowly decomposes over many years itself. Perhaps more importantly, it can hold nutrients. Humus is an anion meaning it is a negatively charged ion that can attract and hold positively charged ions called cations like calcium, potassium and magnesium. The more anions or negatively charged soil particles there are, the greater the cation exchange capacity (CEC) and the greater the capacity the soil has to hold mineral nutrients for plants.

Plant material is where organic matter comes from, but it must come in contact with the soil for the decomposers to turn it into organic matter then humus. One obvious source then would be plant roots that die off when the top is removed or dies back seasonally. This is one reason why some of our naturally richest soils are areas that were historically prairies. Prairie grasses would annually grow huge above and below ground in the summer then die back in the winter. While a lot of the standing brown thatch above ground would volatilize and not contribute much to the soil, with no green support structure above ground, a tremendous amount of roots would die off as well each winter. This loads the soil with organic matter.

Conversely, areas that were primarily forest didn't have that tremendous annual plant debris load added to the soil. The trees might hibernate but their roots didn't die off and contribute to soil organic matter.

When the above-ground portion of the plant is put into contact with the soil, it too can become organic matter and then humus. One way this is often accomplished is through tillage – physically opening up the soil and placing the plant matter into the soil. Unfortunately, tillage stimulates a burst of soil biology activity and often results in burning off as much organic matter as it incorporates.

Another method to put green plant matter into contact with the soil is through grazing. And there is no destructive tillage involved, so it's a complete gain. Livestock can eat the forage and place it pre-digested in the form of manure directly on the soil surface. If crowded close enough together, they will trample down whatever they do not eat. Think of the mile long-herds of bison eating and trampling the prairie grasses hundreds of years ago- constantly on the move in a large pack (that was their instinct to avoid predators) never visiting the same spot more than once or twice a year.

**If ruminants can build soil for cash crops while making us money as well, how do we take advantage of this at Elmwood Stock Farm? By rotating crops and livestock, feeding hay and managing the grazing.**

- 1) We integrate crops and livestock into an eight-year rotation. After five years of perennial forages, we plow the sod and row crop with high-nutrient-demanding but high-value crops for three years. Between the nutrient needs of the crops, the tillage required to get them established and grown to a point of marketability and the fact that we are physically harvesting parts of the crops and hauling them out of the field and off of the farm, this is a net drain on the soil in terms of nutrients, energy, biology and organic matter. Therefore, it is then followed by 5 more years of perennial forages grazed by livestock.

In the food crop producing rotation, we grow high-demanding, long season, high-value crops in the first year on the fertile, freshly plowed sod. This usually includes tomatoes, peppers, eggplant, potatoes, summer squashes, cucumbers and melons. Many of these crops can go late into the fall before a killing frost, so often winter cover crops are planted late and are thus not too tall or thick the next spring. So we would use this second year ground to plant our early, cool season seeds and transplants and/or less nutrient needing crops. This often includes beets, radish, carrots, lettuce, brassicas, chard and turnips. Again, these same type of plants along with overwintering spinach, garlic and onions are planted in late summer and fall of this second year ground. Cover crops are planted on any remaining bare ground. After two years of intensive row cropping and tillage, we figure the soil is getting tired so the third year is primarily used for nitrogen-fixing legumes like peas, cowpeas, edamame, green and dry beans. Then following the third year harvest, the field is so

In the grain-growing rotation, sod is plowed then corn is planted in the first year. In the second year, the corn fodder is plowed and a legume like soybeans are planted to feed themselves. They also put some nitrogen back into the soil in

preparation for the third year crops, which is mostly wheat but sometimes a little more corn. Again, after three years of row cropping, the field is sown into perennial forage, such as mixed grasses and legumes for five years.

The five years of permanent mixed pasture is when the cows work their magic of building the nitrogen and organic matter reserves while improving overall soil structure and fostering a large growth in the amount of microbiology in the soil.

I'd also like to mention a few more points about soil building.

- \*We try to not have much bare ground for too long. We often sow buckwheat and or small grains in drive rows.

- \*We have about 10 acres of raised beds with black plastic mulch each year, but we sow grass in the soil between the plastic rows and mow it all summer with a walk-behind sickle mower.

- \*While our grazing and hay feeding is fundamental to our fertility program, it results in a lot of weed issues. We do a lot of cultivation and chopping, but we do not practice long-term fallow periods. Long periods of nothing grown and tillage to kill weeds would also allow a lot of biology to die, organic matter to decrease, and carbon and nitrogen to escape. Instead we utilize rapid successive cover crops incorporated as green manure when trying to knock back weed pressure.

- 2) How we manage the cattle determines how well they are able to work their magic and improve the soil over those five years as opposed to draining and depleting it themselves. How livestock are allowed to graze determines if there is a positive or negative impact on the animal, the forage and the soil. We move our cattle anywhere from daily to weekly, depending on the group and our goal. For example, we finish our animals before we take them to the butcher. While we use only forages and no grain, we still want to sell nothing less than a choice grade cut of beef. So this requires us to manage their pastures and rotations with those animals needs as the first priority. In order for them to get fat and finish to a well marbled ribeye, they have need to have available all they could possibly want of the highest quality forages for a very long time. So our finishers, unlike any other class of livestock, are managed in a manner to benefit them first and foremost.

The cows and calves are managed in a manner that focuses more on the benefits to the soil. This is where the cow part of the program is so important. While it might seem more profitable in the short term to buy in weanlings and then finish them, it is difficult to build the soil very quickly and manage the finishers in a way that will allow them to truly finish. A cow, on the other hand, has the capability to get fat and then lose weight and get fat again. Also, when a cow is not nursing, she has a low requirement for maintenance, so she can gain



weight and get fat in preparation for raising her next calf on next to nothing. This gives us an opportunity to graze the cow in a manner that optimizes soil building, yet she is still able to do well and prepare herself for raising her next calf. Even when she is nursing, because she had a few months to get fat, she can be managed in a manner that still benefits the soil to some degree yet does not put her under undo stress.

How you rotate grazing animals determines everything. What are the variables? Density or the number of animals per area. Duration or how long the animals are on that particular spot. And then recovery or how long that spot has before it is grazed again. Set stocking is when there is no rotation. With any significant density, this is terrible on the soil and forage and then eventually the animals because of selective grazing. At a really low density, this could be a great way to finish an animal. One steer on 20 acres is going to get fat!

One type of rotation system or style is called MIG or management intensive grazing. It basically teaches you how to manage for greatest efficiency by maximizing forage growth. It emphasizes recovery time combined with density or duration management as the way to maximize forage growth by never grazing too short yet never letting forage get mature. By maximizing forage growth, you are, in turn, able to maximize total animal pounds that can be supported. It is great at teaching you how to manage rotations and livestock and forage growth.

Another system or style is Mob grazing, which utilizes very high density for a very short duration followed by a long recovery to basically mimic the herds of bison that historically were so effective at building our soils in this country. The super high density for a brief amount of time results in all the forage being placed onto the soil profile (as manure or trampled litter) without actually doing any tillage. A green manure cover crop is being incorporated into the soil with no tillage! This is a great way to build the soil but maybe not the best way to finish animals in a timely fashion or maximize the number of animals you can run.

There is an argument that has some merit that says as you build the soils it will grow more forage and you can run more and more cattle on the same acreage. I think this may be the case initially on poor soils, but at some point there cannot be too much more forage grown in one spot, then the long recovery periods become the limiting factor in the stocking rate and it can be somewhat inefficient.

We use a combination. Basically we generally move the cows every other day or three days a week. From the cows' rumen perspective, research shows that they can eat lush, tender green stuff one day and less palatable, tougher brown stuff on alternating days. It all digests well in the rumen and does not cause the profile of the rumen biology to change. So the cow gets to selectively graze some the first day, then she has to eat the stuff she didn't want on the second and the rumen digests it like she ate a nice mixed diet all at once. Changes in the diet

that occur more than a day apart, is inefficient because it keeps the rumen biology confused.

From the forages perspective most (but not all) of the forage is either consumed or trampled in those two days yet there is not enough time for the most preferred to forages to start regrowth and be consumed again or re-grazed. So there is not too much selective grazing allowed in that time period which would favor the less desirable forages over the more preferred ones.

From the soil's perspective, this is not quite as beneficial as mob grazing. It is not quite the density nor quite as short of duration as mob grazing, but a two-day duration is pretty short and it is dense enough to have consumed or trampled nearly 2/3s of standing forage on average each cycle. Plus, with shorter rotations (4-6 weeks on average), we are growing more total forage in the year and its being incorporated more often when compared to mobbing.

In the fall, we stockpile forages for early winter grazing. In mid-August, we quit grazing a portion of our farm that has good stands of cool season grasses to allow them to grow and stand for winter grazing. When that portion of the farm is being stockpiled, the cattle graze the pastures that have alfalfa (since it does not winter well as a standing forage) as well as a different portion of the farm that is set aside to summer stockpile. Both the summer and winter stockpiling areas are then grazed in small, daily, high-density slices. So we do some mob grazing each year in different areas of the farm to benefit the soil and forages.

- 3) Hay. On our farm we have many acres that are too steep to till, so they remain in perennial forages. By baling hay off of those fields and only feeding hay on tillable acreage we are literally making the "lazy" part of the farm help support the part of the farm that does get tilled and does have some of its production hauled away. Through physically moving hay around the farm, these non-tillable areas which have had their soil improved through managed grazing as well, are also made to contribute to the cash crop production.

### **Does it work?**

#### **Functionally:**

We farm 550 acres. We row crop 75-90 acres per year. We keep 80 cows, their calves, yearlings and 2-year-old finishers. About 25 ewes and their lambs, finish 20+ pigs, 300 laying hens, 25 turkey hens and seasonally 3,000 broilers and 200-300 turkeys. We do this with no significant off-farm fertility inputs and not a lot of inputs in general. Our off-farm production inputs mostly include: fuel, minor grains and ingredients to mix with our grains for the poultry and pig rations, salt and grit for the livestock, lime and crop protectants.

This production method allows us to supply about 500 families with most of their produce and some of their protein needs for half a year with around 100 getting their produce from us for more than 3/4 of the year through our CSA programs. We distribute a similar amount of produce and protein by volume through six farmers' markets and sell still more to restaurants, groceries and other wholesale channels. This is all grown with less than a hundred pounds of purchased crop fertilizer a year. (1-2 ton each of lime and sulfate of potash every 6-10 years on crop land).

#### Economically:

We grew 130 bushel/ac corn and 50 bushel/ac soybeans this year. 120 corn and 40 soybean last year using this rotation with no purchased inputs other than the seed and the fuel for the equipment.

125 bu organic corn x\$10=\$1250-\$50 seed cost =	\$1200
40 bu organic soybean x\$25=\$1000 - \$50 seed cost =	\$950
30 bu organic wheat x\$15=\$450	\$450
Beef from birth to plate from the rebuilding 5 acres	
Including cows, calves, yearlings, finishers: \$2500-\$100 salt/fence=	<u>\$2400</u>
<b>Return per 8 acres before rent, fuel, labor</b>	<b>\$5000</b>
<b>Per acre return commodity farming this way:</b>	<b>\$625/acre</b>

#### Ecologically:

University of Kentucky research on soil biology and soil carbon. We have one year's data from some UK research. They take soil samples four times a year from each of the five crop fields "resting" in the pasture stage of the rotation and from one permanent pasture field as the control. After the first year of collecting data, there seems to be a pattern of soil biology, soil carbon and soil nitrogen all rebounding after being taken out of tillage and put back into permanent pasture. Most of the data trended upwards to the point that soil microbiology, carbon and nitrogen were all approaching the levels of the permanent pasture after years four or five of the rotation. Again, this is only one year, but this is encouraging. This is what we were hoping was happening.

#### **UGA/UK energy study**

Michael Pollen says that it takes 10 calories of fossil fuel to produce one calorie of food.

Dr. Michael Bomford stated at an OAK conference in Berea, KY a couple years ago when talking about an energy study he was conducting at KSU that on average it takes 12 calories to produce one calorie of food.

One-year study in conjunction with UGA and UK we used 7.5 calories to produce one calorie of food.

Given: There is approximately 7.7 billion acres of arable land in the world. There are approximately 7.4 billion people in the world. So let's say there is 1 cropable acre per person. Also, 'The Economist' recently published that we Americans eat one ton (2000#) of food a year.

In our eight-year rotation, if we were to grow one acre of tomatoes on first year ground, one acre of kale on the second year ground and one acre of sweet potatoes on the third year ground and then raised 1.25 cows, their calves, their yearlings and their two-year old finished beef. This is a total of eight acres. So divide the year's production by 8 and I figure we have produced 5000# of vegetables and 80# of meat per acre or person per year. That is more than twice the weight in vegetables alone one person needs and 3.5 ounces of beef a day. So I think we can feed the world healthful, life promoting food farming this way!

## **Summary**

Growing crops and livestock together have been fundamental to Elmwood Stock Farm's success and longevity.

Ruminant livestock can be an income source as well as the main source of fertility and pest prevention.

This is accomplished by managing their grazing to be a sort of blend of both Mob and MIG grazing styles to maximize the combined benefits of both. The soil building associated with high-density, long-recovery mob grazing and the production maximizing benefits of keeping forages growing of management intensive grazing.

The result is you get paid to not buy fertilizer. And through increased organic matter, nitrogen and biology the soil becomes consistently healthier resulting in fewer required pest and irrigation inputs.